

Fermilab Research Program Overview

Quick tour of the program

Summary

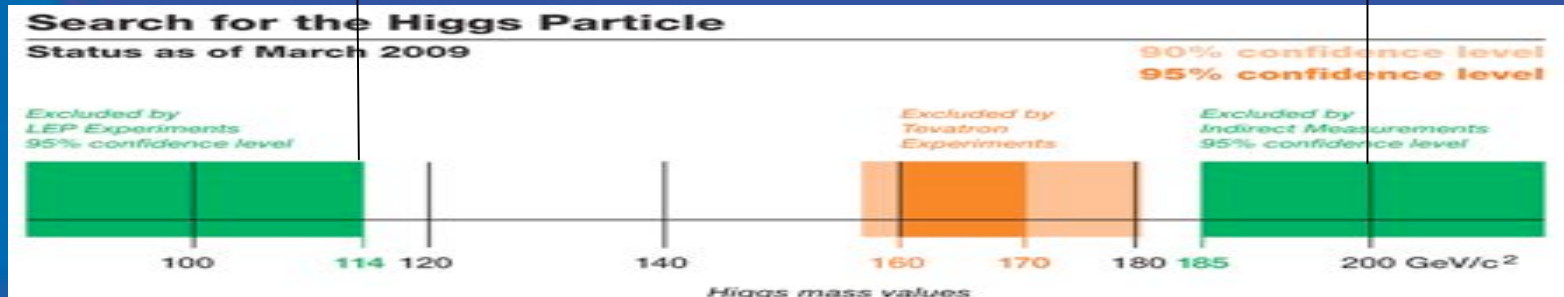
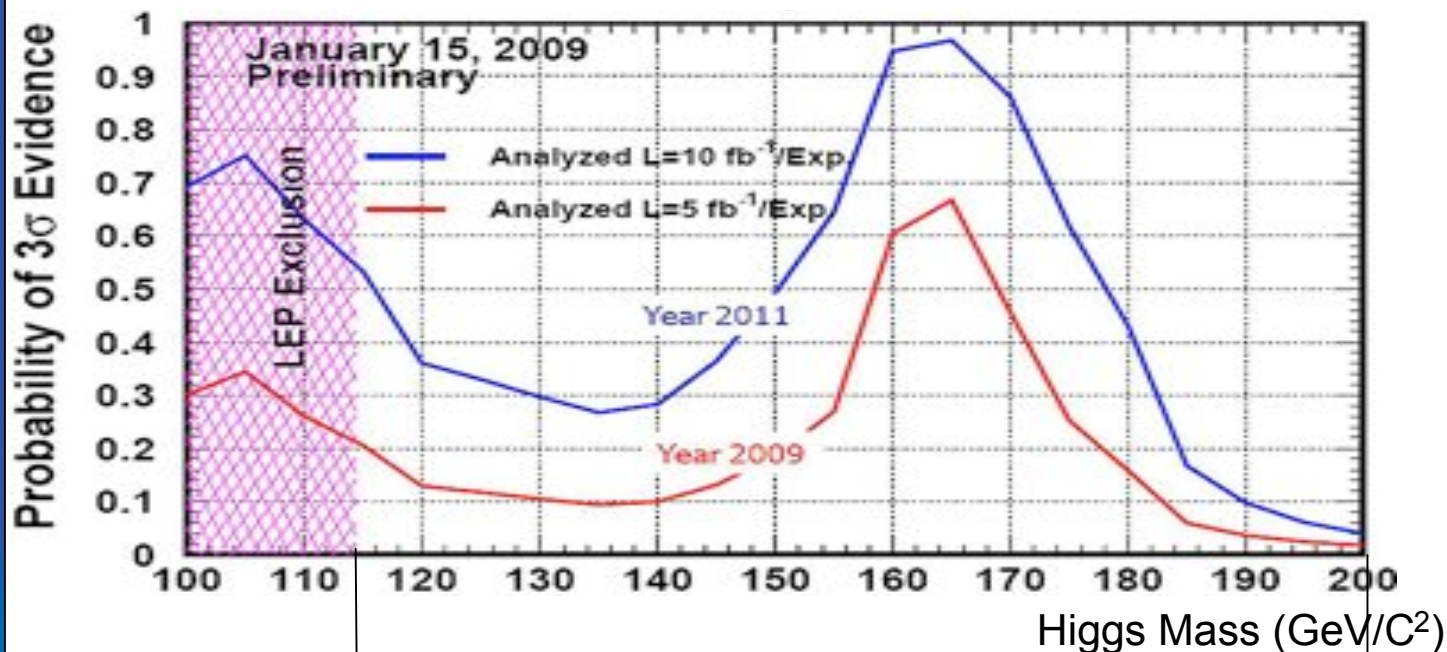
Greg Bock
CDF International Finance Committee Meeting
Fermilab
30 October 2009

Strong program across all three frontiers

Energy Intensity Cosmic				
	Tevatron LHC		LHC LHC upgrades	LHC ILC?? CLIC or Muon Collider
	Minos MiniBooNE		NOvA MicroBooNE MINERvA	LBNE Mu2e Project X+LBNE Mu2e ν Factory
Cosmic	P Auger DM Searches		P Auger DM: scalable? DES	JDEM DM searches
	JDEM			
	Now	2012	2015	2018

Progress: Higgs at the Tevatron

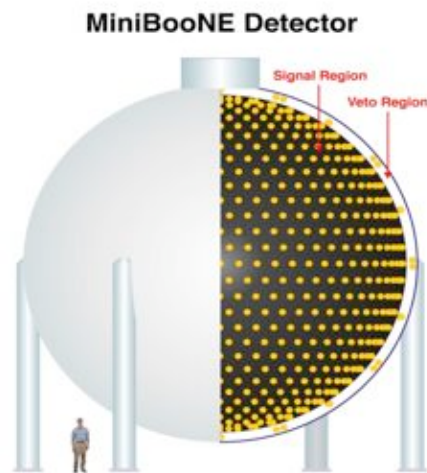
Sensitivity Projection (Region favored by M_{top} , M_W , ... meas.s)



Highlights of the Tevatron Experiments

- More than 1 paper/week published
- ~ 200 preliminary results announced per year
- ~ 400 invited talks at conferences
- ~ 50 PhD's awarded/year

Neutrinos



MINOS

Results on $\bar{\nu}_e$ appearance
Antineutrino results and run
MiniBooNE
Antineutrino running

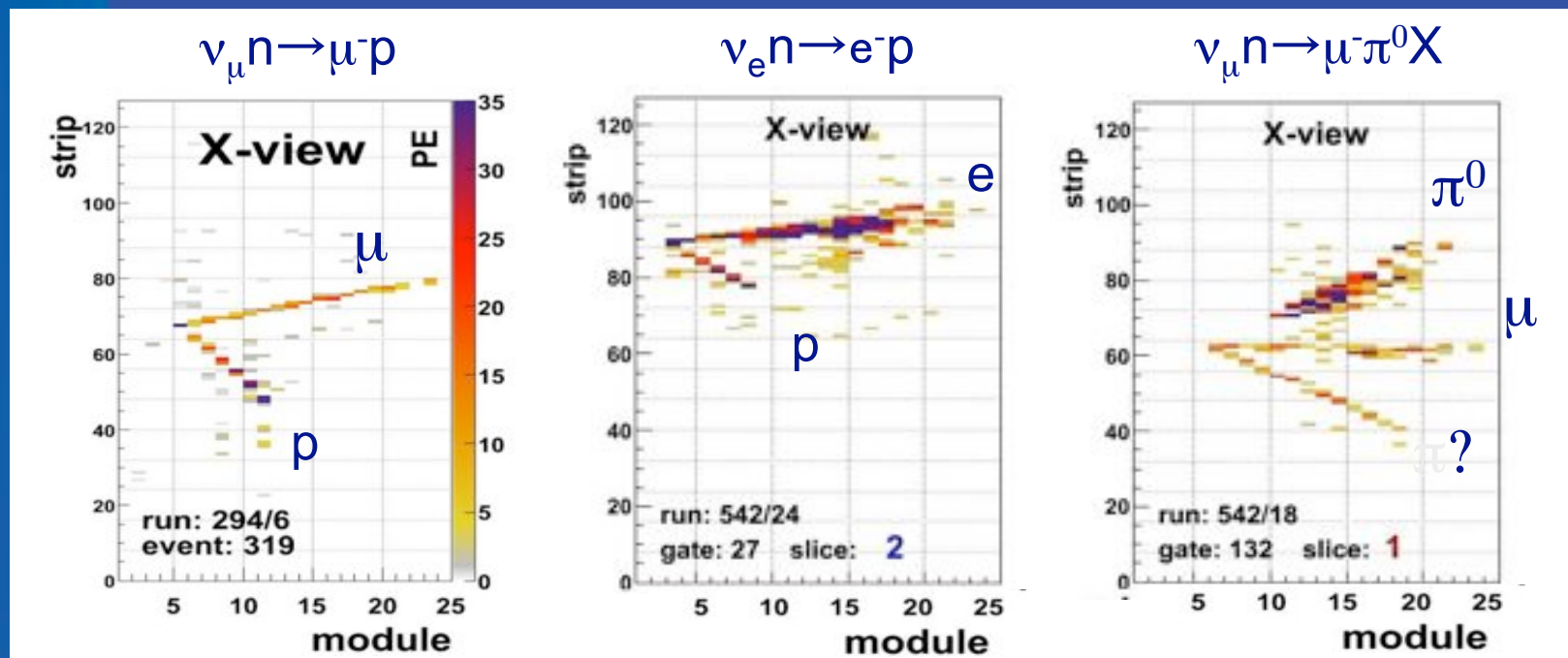
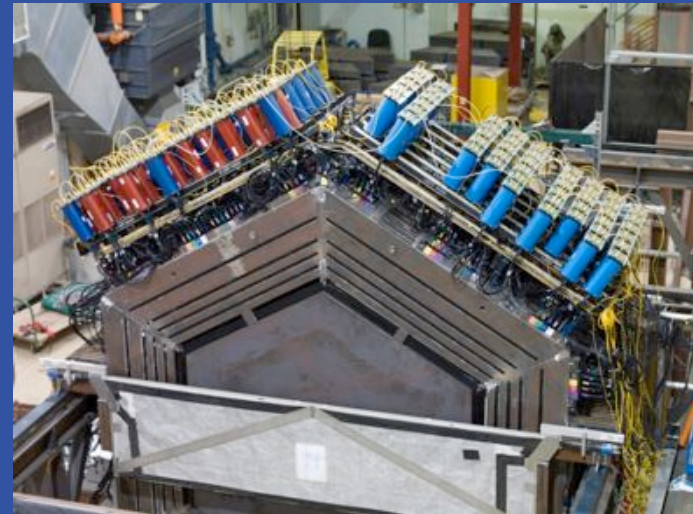


Minos Far Detector

MINERvA Data

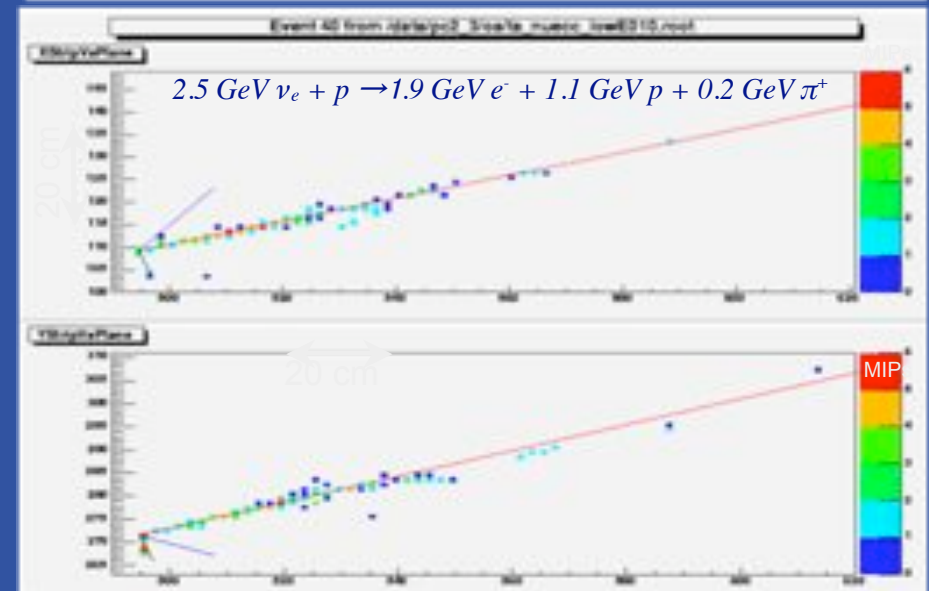
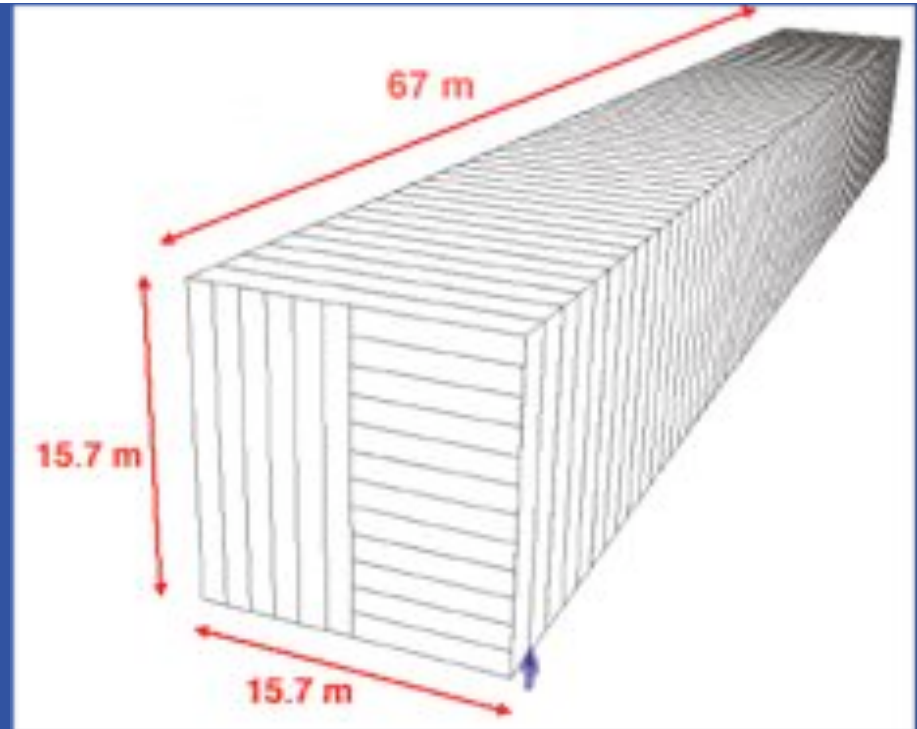
Prototype took data Apr.15 ~Jun.15
15k events, publishable physics

Data taking with 50% det: Nov 2009
Full det.: Summer.2010



NOvA

- NOvA is optimized for the detection of $\nu_\mu \rightarrow \nu_e$ and $\nu_\mu \rightarrow \nu_\tau$ oscillations
- CD 3b expected soon
- NOvA is:
 - An upgrade of the NuMI beam intensity from 400 kW to 700 kW
 - A 14 kt “totally active” tracking liquid scintillator calorimeter sited 14 mrad off the NuMI beam axis at a distance of 810 km
 - A 215 ton near detector identical to the far detector sited 14 mrad off the NuMI beam axis at a distance of 1 km



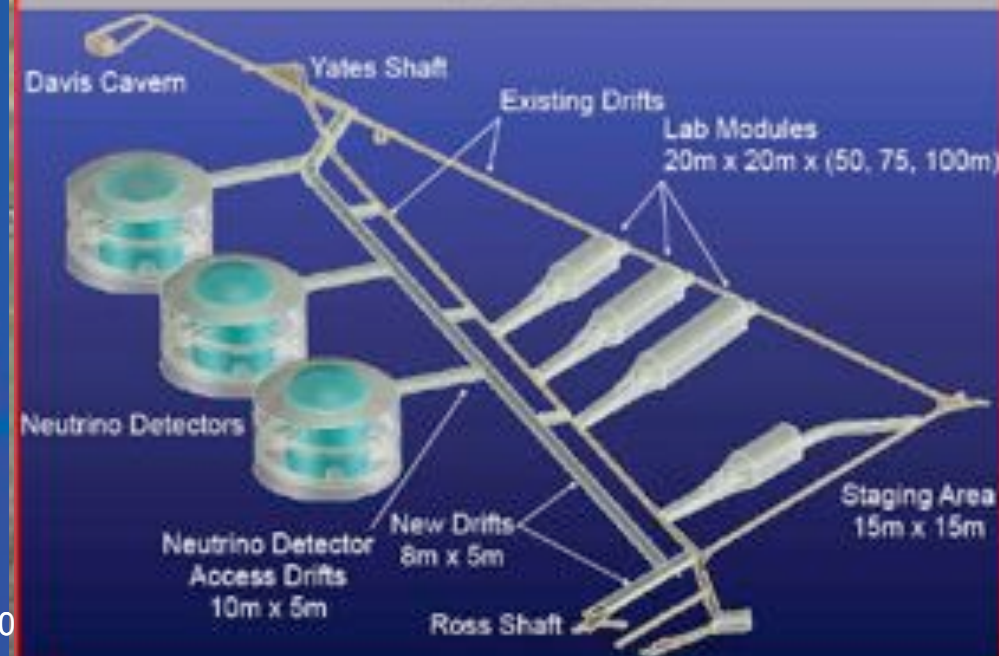


NOvA



Long Baseline Neutrino Experiment

4850 Level Conceptual Layout



ArgoNeuT

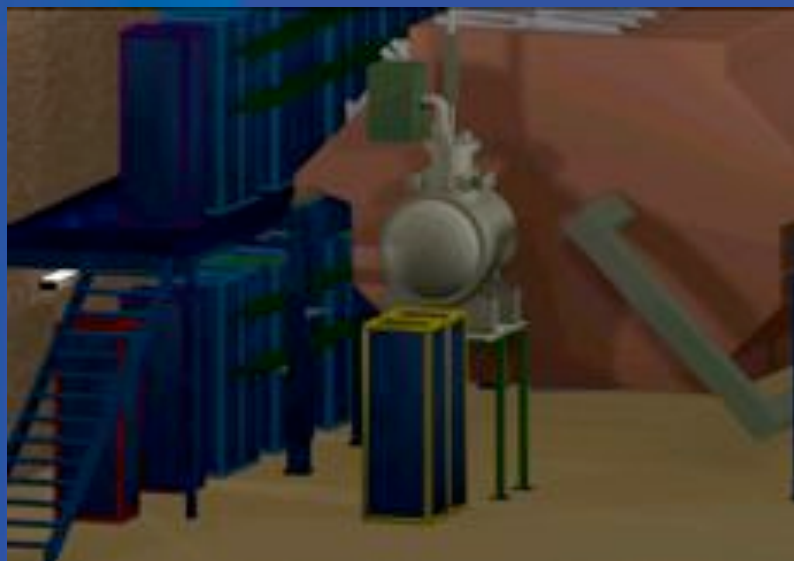
Operational

Physics: Measure neutrino-argon cross sections



0.0003 kton

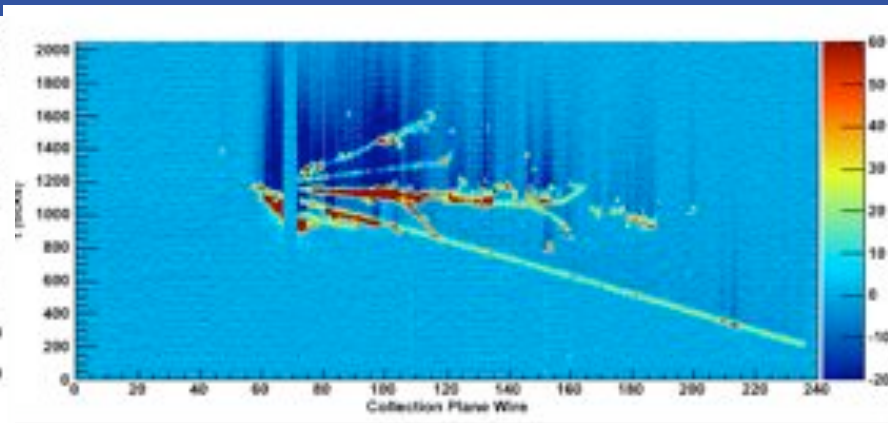
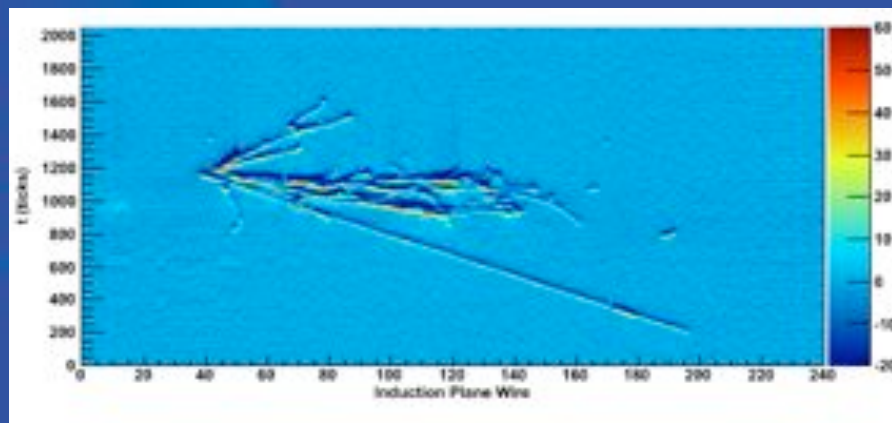
330x



Installation and
Commissioning
Underground



0.3 ton TPC using MINOS to catch muons



Data run began mid-September, expect 20kg neutrino and anti-neutrino events by March



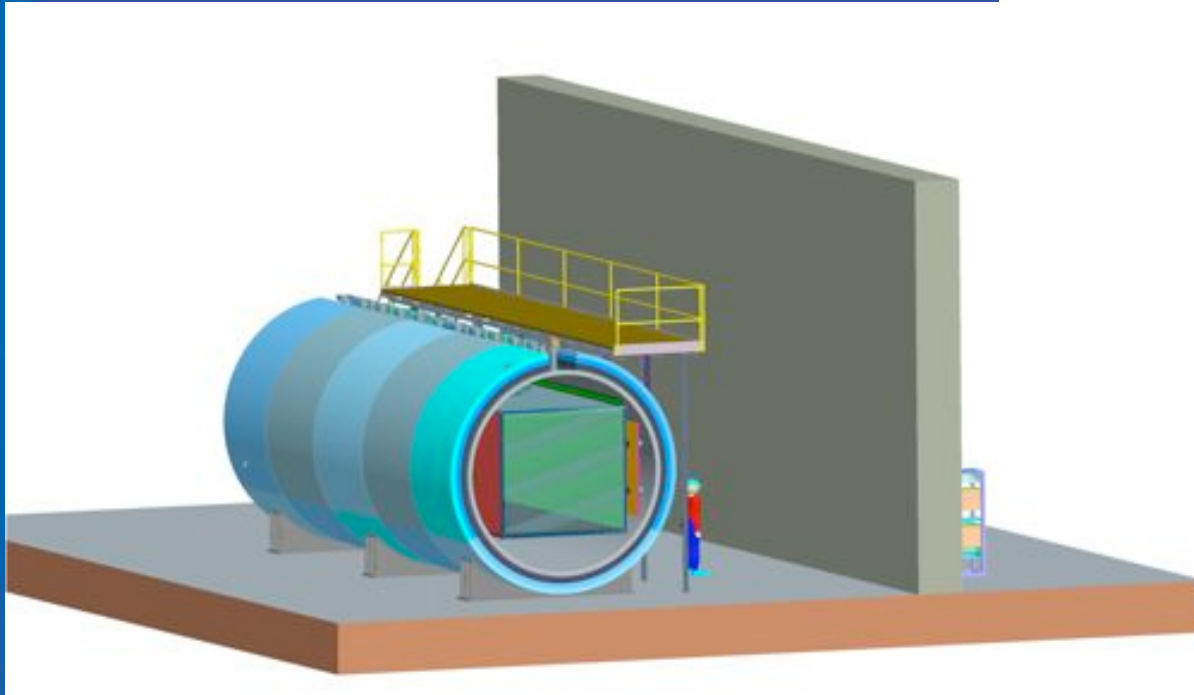
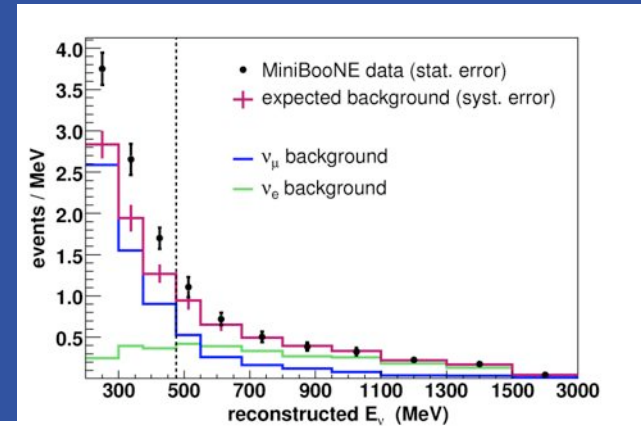
MicroBooNE

- ~100 Tons
- Cold electronics
- Purity
- Measure physics xsecs and sensitivities
- Test ease of surface running
- Develop tools for Analysis

Measure low energy neutrino Interactions:

- MiniBooNE low energy excess
- Suite of low energy cross section mmnts.

MicroBooNE Physics

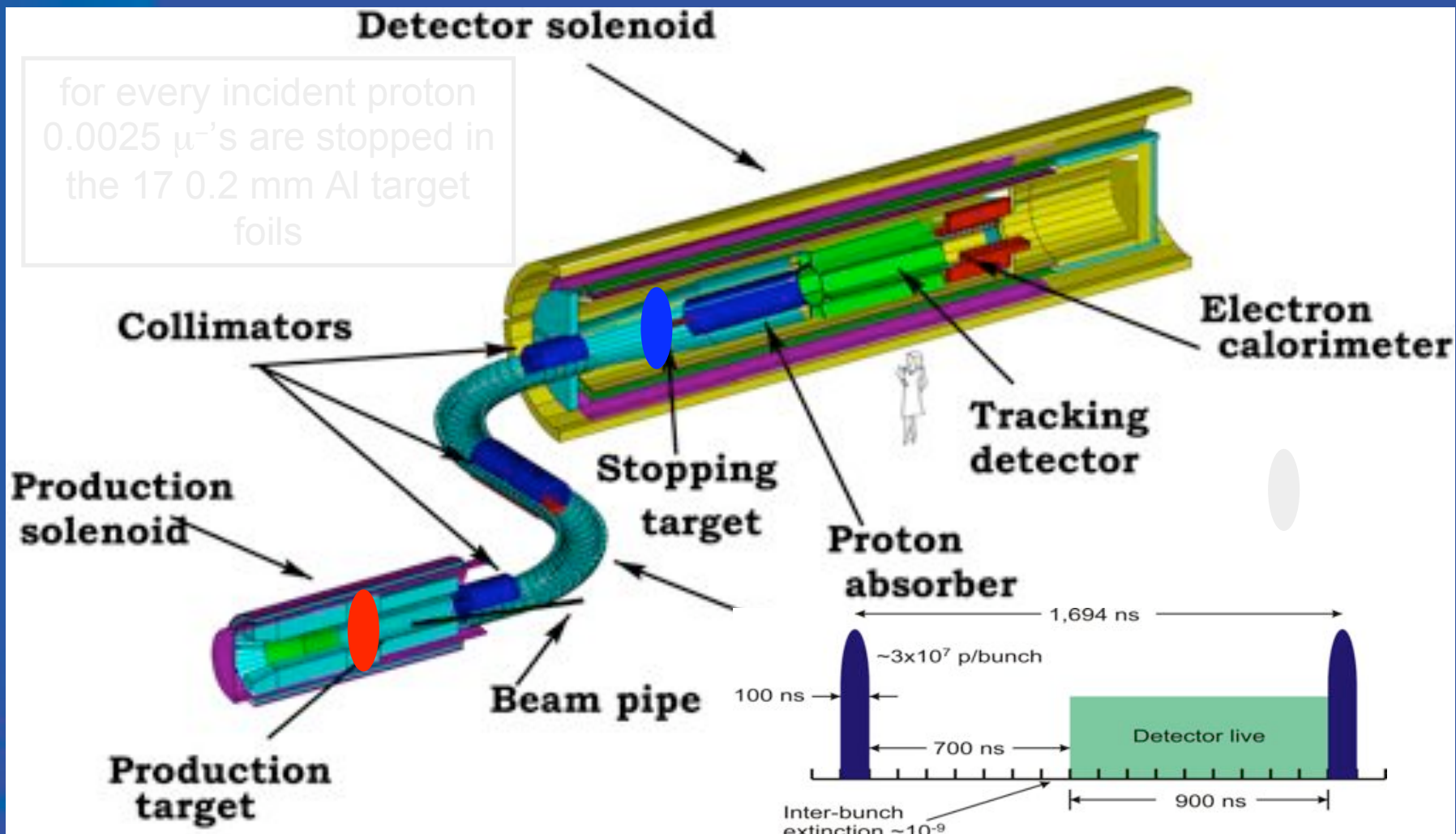


Fermilab Stage 1
approval in 2008

CD-0 (Mission need)
from DOE last week

Partial funding through
NSF MRI and proposals
(1.5M total)

μ to e Conversion ($\mu N \rightarrow eN$)



MECO spectrometer design

CMS is ready for data taking and analysis
LHC Physics Center at Fermilab is ready
Upgrade Workshop October 28-30



CMS

Underground dark matter detectors

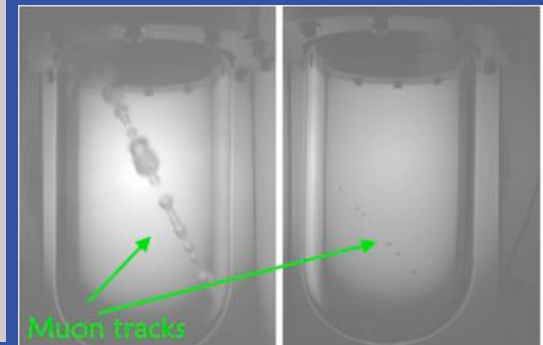
CDMS

Low temp. Ge / Si crystals



4 kg \rightarrow 15 kg

COUPP
60 kg / 30 liter



2 kg / 1 liter

COUPP

Room temp. CF_3I Bubble Chamber

Probing Dark Energy

1. SDSS (Sloan Digital Sky Survey)
 - 2.5 meter telescope in New Mexico
 - Ranks as the facility with the highest impact in astronomy for the 3rd year in a row.
 - Power spectrum of galaxies constrain dark energy density parameter.
2. DES (Dark Energy Survey)
 - 4 meter telescope in Chile
 - DES Camera: operational 2011
3. JDEM (Joint Dark Energy Mission)
 - Space telescope
 - Fermilab Goal: Science Operation Center
 - Maintaining R&D effort now



Cosmic Frontier: Pierre Auger



Auger South

Correlations continue
5 more years of running
Composition of showers
Paper in preparation

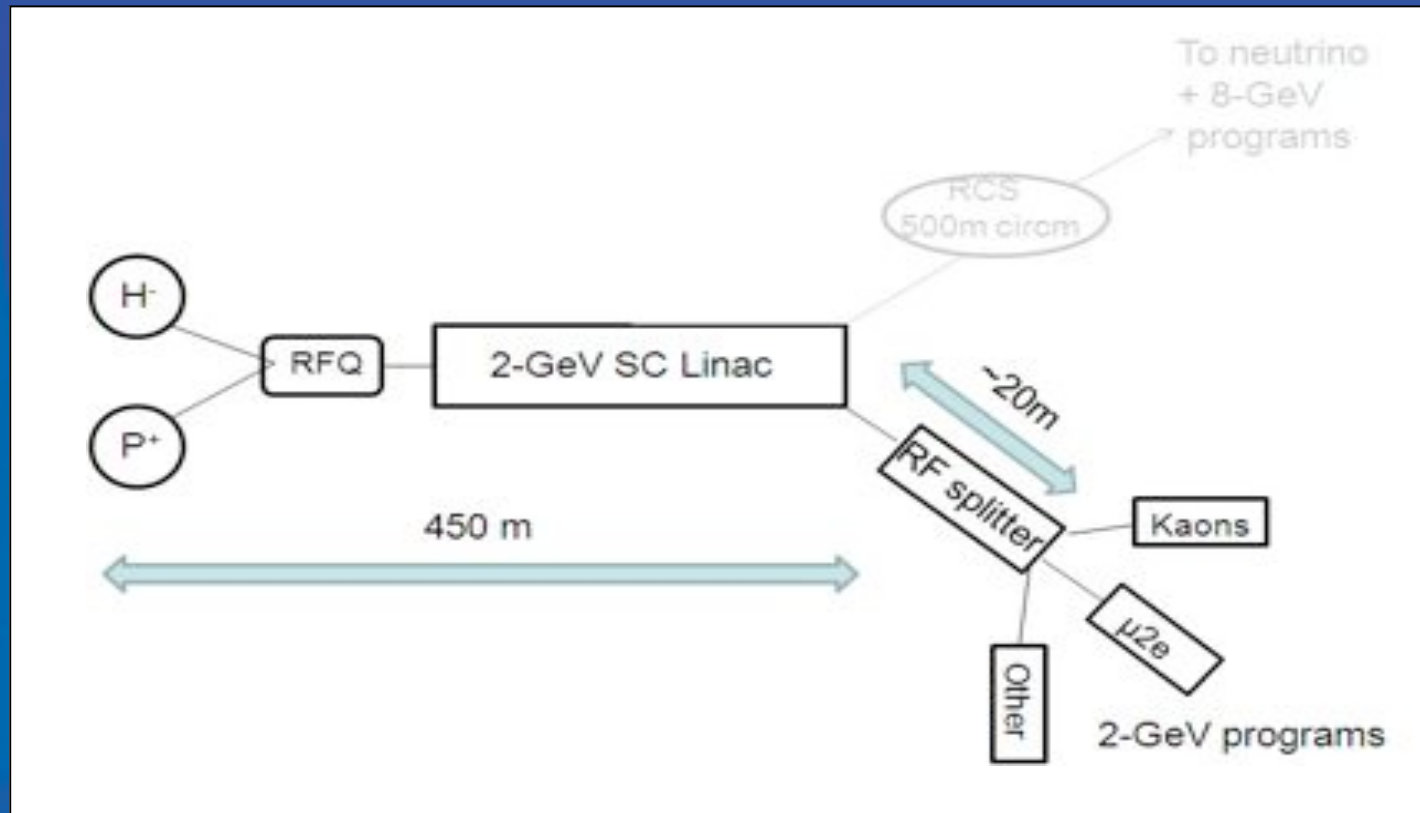


Auger North

7 X Auger South Area
Proposal submitted

More intensity Frontier opportunities: Project X and 2 GeV beams

- The greatest potential for rare processes comes from 2 MW continuous beam. Intensity experiments need continuous beam: pile up is the main limitation in pulsed beams



Draft 2010-13 Fermilab Accelerator Experiments' Run Schedule

Typically Revised Annually - This Version from October, 2009

Calendar Year		2010	2011	2012	2013
Tevatron Collider		CDF & DZero	CDF & DZero	OPEN	OPEN
Neutrino Program	B	MiniBooNE	MiniBooNE		OPEN
		OPEN	OPEN		MicroBooNE
	M	MINOS	MINOS		OPEN
		MINERvA	MINERvA		MINERvA
		Argonne?			
				NOvA	NOvA
SY 120	BT	Test Beam	Test Beam		Test Beam
	MC	OPEN	OPEN		OPEN
	MS	E-906/Drell-Yan	E-906/Drell-Yan		E-906/Drell-Yan

This draft schedule is meant to show the general outline of the Fermilab accelerator experiments schedule, including unscheduled periods.

Major components of the schedule include shutdowns:

In Calendar 2010, a 4-6 week shutdown for maintenance is shown.

In Calendar 2011, no shutdown for maintenance is shown.

A 2012-3 11-month shutdown is shown to upgrade the proton source and change the NuMI beam to the Medium Energy (ME) config.

- RUN/DATA
- STARTUP/COMMISSIONING
- INSTALLATION
- M&O (SHUTDOWN)

19-Oct-09

Programs / Projects at Fermilab (Technically Limited Schedule)

Programs / Projects	FY08	FY09	FY10	FY11	FY12	FY13	FY14	FY15	FY16	FY17	FY18	FY19
Energy Frontier												
Tevatron: CDF	Operation				Data Analysis							
Tevatron: DZero	Operation				Data Analysis							
LHC: CMS	Operation											
LHC: ATLAS					Operation							
LHC Phase I Upgrade	R&D			Construction								
LHC Phase II Upgrade	R&D			Construction								
Lepton Collider	R&D			Decision			ILC or CLIC/Muon Collider					
Intensity Frontier												
ν : SciBooNE	Data Analysis											
ν : MiniBooNE	Data Analysis											
ν : MicroBooNE	R&D	CD-0	CD-1/2	Construction			Data Analysis					
ν : MINOS	Data Analysis											
ν : MINERvA	CD-3b	Shutdown			Data Analysis							
ν : NOvA	CD-2	CD-3a	CD-3b				Data Analysis					
ν : Long Baseline at DUSEL		CD-0	CD-1	CD-2	CD-3a			Data Analysis				
μ : Mu2e		CD-0	CD-1	CD-2	CD-3a							
Project X		CD-0	CD-1	CD-2	CD-3a							
Cosmic Frontier												
Dark Matter: CDMS	4 kg	15 kg				~1 ton scale detector						
Dark Matter: COUPP	2 kg	60 kg				(tech choice: CDMS, COUPP, LArTPC, ...)						
Dark Energy: SDSS	Data Analysis											
Dark Energy: DES	CD-3a				Data Analysis							
Dark Energy: JDEM	R&D											
Cosmic Rays: Pierre Auger	South				North to be determined							
Other Facilities												
Testbeam for Detector R&D	Operation				Shutdown							
Accelerator Research at A0	Operation											
SCRF Test/ Accel. Research	Construction						Operation					
Lattice QCD	Operation											

New Ideas keep coming.

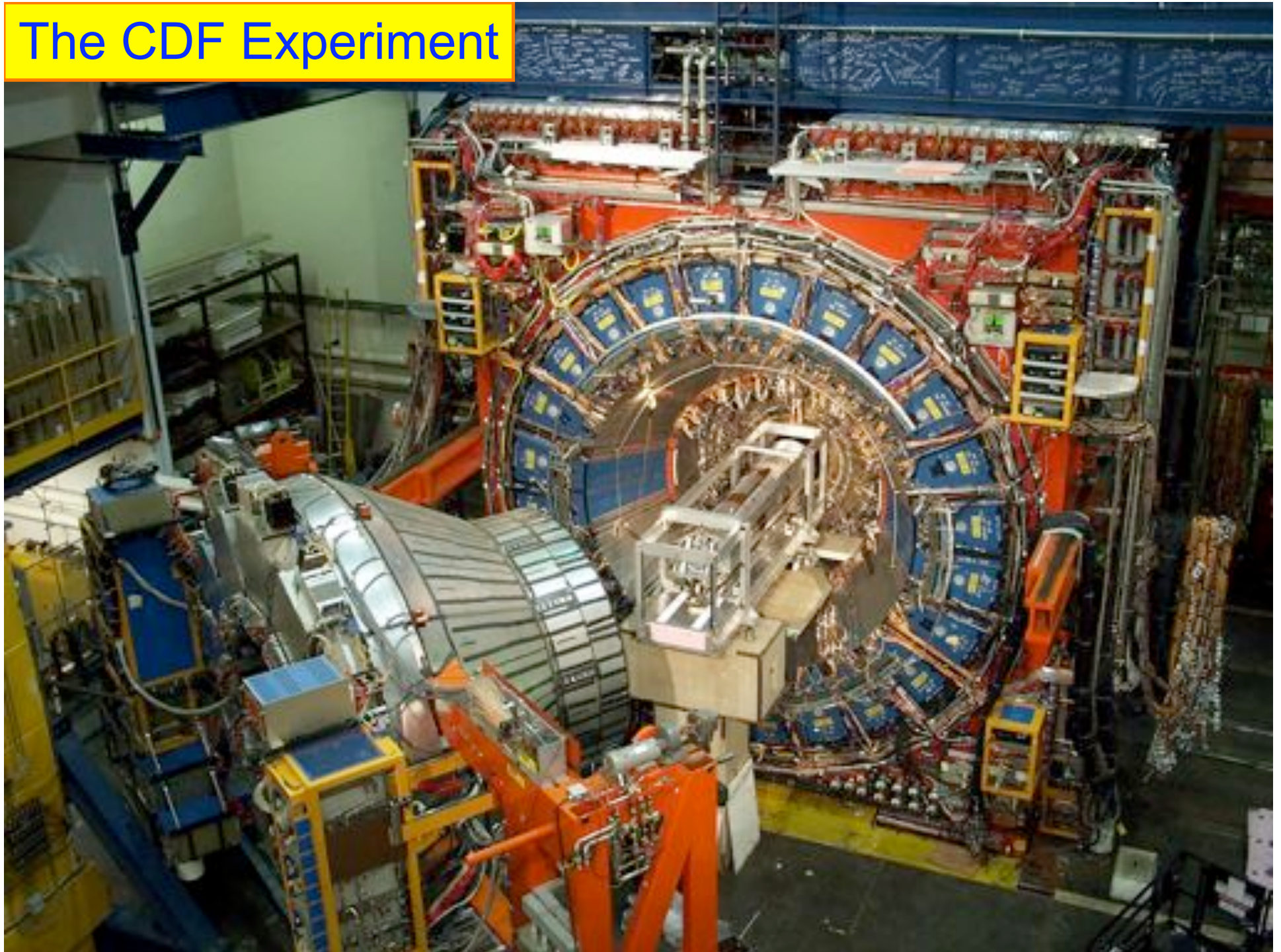
Recent submissions to Program Planning include:

- Auger North Fermilab role per NSF proposal
- Holometer Experiment Proposal
- COUPP 60 kg at SNOWLAB
- QUIET Phase II
- Noble liquid dark matter search
- MAX R&D for DUSEL, and DArKSIDE
- SciNOvA - SciBar Near Detector Off Axis at NuMI (Mark Messier and Rex Tayloe)
- Resonant Regeneration Axion Search
- $K^+ \rightarrow \pi^+ \nu \bar{\nu}$ with Tevatron stretcher
- MiniBooNE Near Detector: BooNE (Bill Louis)
- ν Communication Demonstration

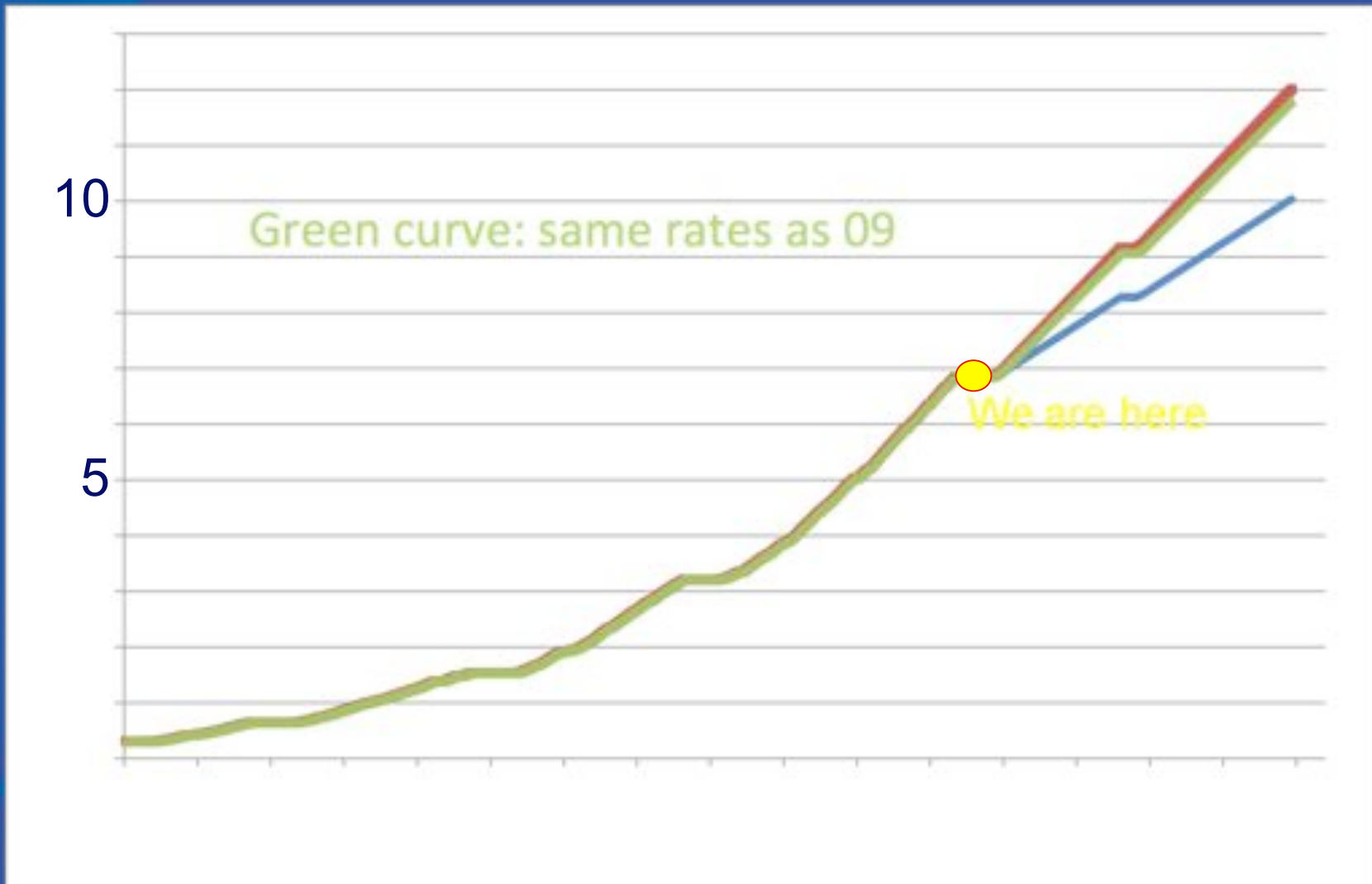
Overall State of the Research Program

- Extremely strong and diverse across all three frontiers
 - Running experiments
 - Projects under construction
 - Projects working their way through the system towards construction
 - New ideas from the user community are still emerging
- Challenges are
 - Preparing for the Intensity Frontier
 - Adapting to changes in funding agency
 - Adopting best practices
 - Restoring infrastructure

The CDF Experiment



Tevatron through FY11



The CDF Collaboration

North America

“ 33 institutions

Europe

“ 21 institutions

Asia

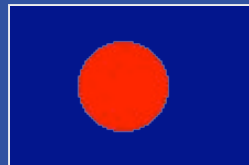
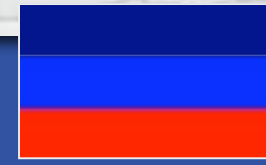
“ 8 institutions

The CDF Collaboration

“ 15 Countries

“ 62 institutions

“ 602 authors



The CDF Physics Program

- Precision, new research and discoveries
 - Mixing, CKM Constraints, and CP-Violation
 - Heavy Flavor Spectroscopy
 - New Heavy Baryon states
 - Tests of QCD and HF production
 - Top-quark and W-boson Masses
 - Top quark properties
 - Di-Boson production and SM Gauge Couplings
 - New exclusive/diffractive processes
- Unique window into the unknown
 - Searches for Supersymmetry, Extra Dimensions, other Exotica
 - Still at the Energy Frontier
 - Probing the Terascale as luminosity increases
- The Standard Model Higgs is now within reach !

Addressing questions of fundamental importance

Productivity Remains High

- Productivity is higher than ever
 - Near 50 new results between Winter 09 and Summer 09 !
- Tevatron results remain dominant in HEP conferences
- > 150 CDF conference talks/year !
- ~30 PhD's in the past year
- 52 CDF papers published in 2009 and counting
- Still in some areas CDF is only scratching the surface
- Much potential for further precision, reach and discovery

Summary

- Laboratory is committed to running the Tevatron and CDF through FY11 and continuing support for analysis thereafter
- All the laboratory's divisions, sections, departments, and groups have been planning to run through FY11 for some time
- The DOE is requesting funds to run in FY11
- The final years will not be without challenges, but we will make it through!